2008 Aviation Safety Technical Conference

IVHM Project

Intro to Research Test and Integration

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Project Scientist
Integrated Vehicle Health Management Project
NASA Aviation Safety Program

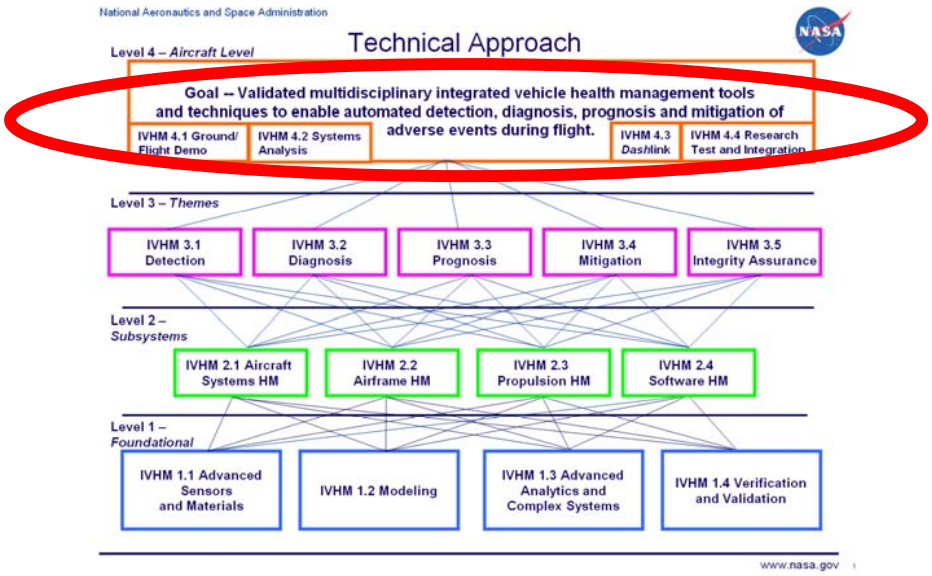
Intro to Research Test and Integration

IVHM Level 4 – Aircraft Level

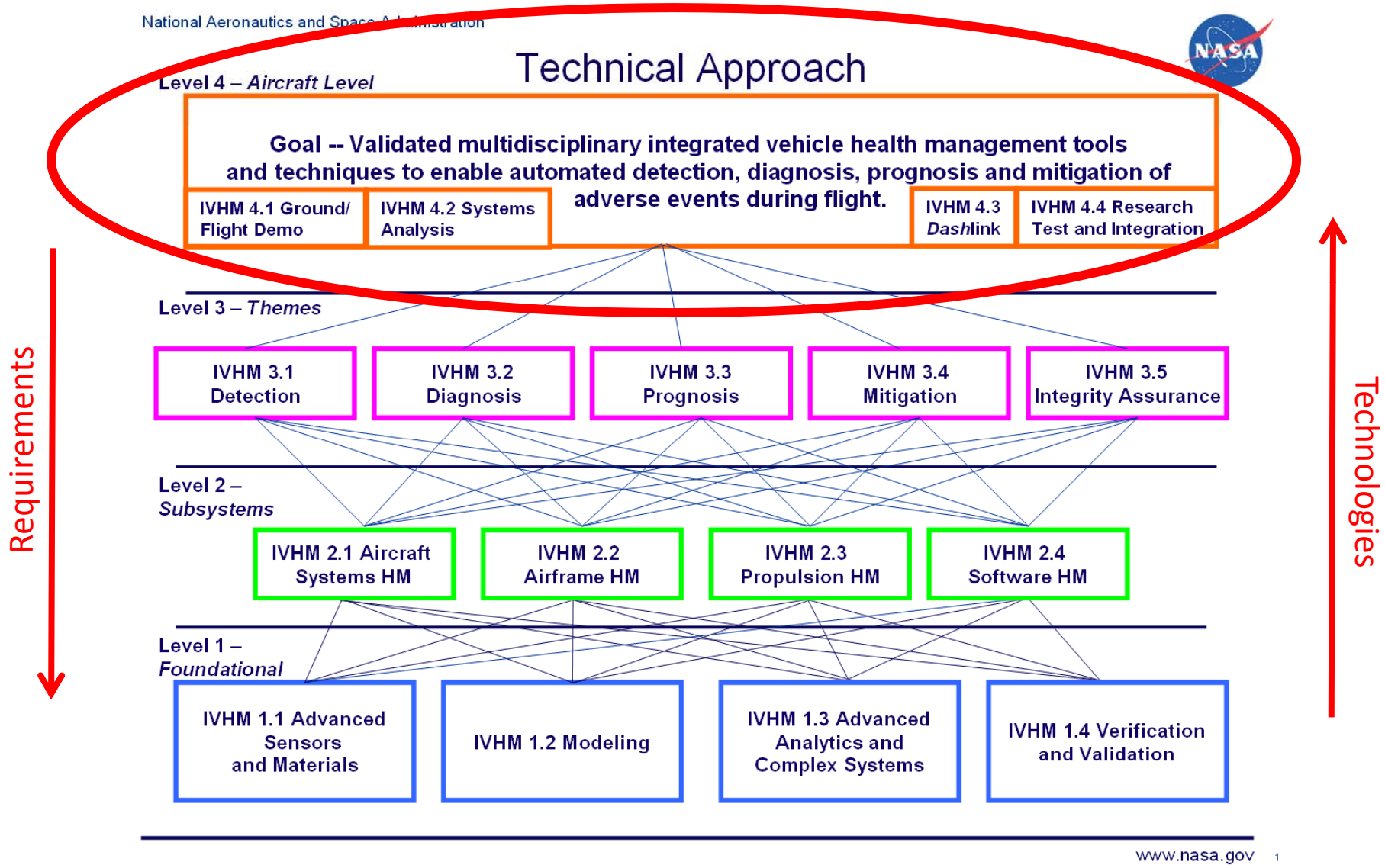
Overview

Progress Status

Expected Outcomes



NASA IVHM Project Research Framework



•**Table 2. IVHM Adverse Events Table:**

IVHM Level 4 – Vehicle Level Overview

- Systems Analysis Team
  - Eyes looking at past, present, and future IVHM needs and requirements

IVHM Tech Plan
Table 2. IVHM Adverse Events Table:

Adverse Event Type	Example Damage Condition	Severity and (Frequency)
Incipient Fault: Hard to detect and differentiate due to extremely slow degradation in performance	1. Icing conditions in propulsion system	1. (tbd)
	1. Fault of power electronics -Power drivers -Power supplies -Switching transistors -Electronics packaging -Electronic circuit boards	2. Accident (21) Incident (302)
	1. Turbine engine bearings -Fatigue spallation	3. (N/A)
Slow Progression Fault: Very hard to detect, gradual degradation in performance	1. Fatigue cracks on metallic airframe structure	4. Accident (13) Incident (343)
	1. De-lamination in composites	5. Incident (N/A)
	6. Ball-jam in EMA -Hydraulic actuator failure	6. Accident (18) Incident (516)
	7. A/C and pressurization faults	7. Incident (408)
	8. Oil/lubrication system failures	8. Incident (463)
Intermittent Fault: Fault does not degrade but instead is a recurring hard fault that comes and goes. For example, a signal conducted via a loose connector.	9. Wire chafing resulting in an electrical short due to an unexpected ground path	9. Accident (N/A)
	10. Electrical distribution problems	10. Accident (N/A) Incident (244)
	11. VHF/transponder failures	11. Accident (5) Incident (461)

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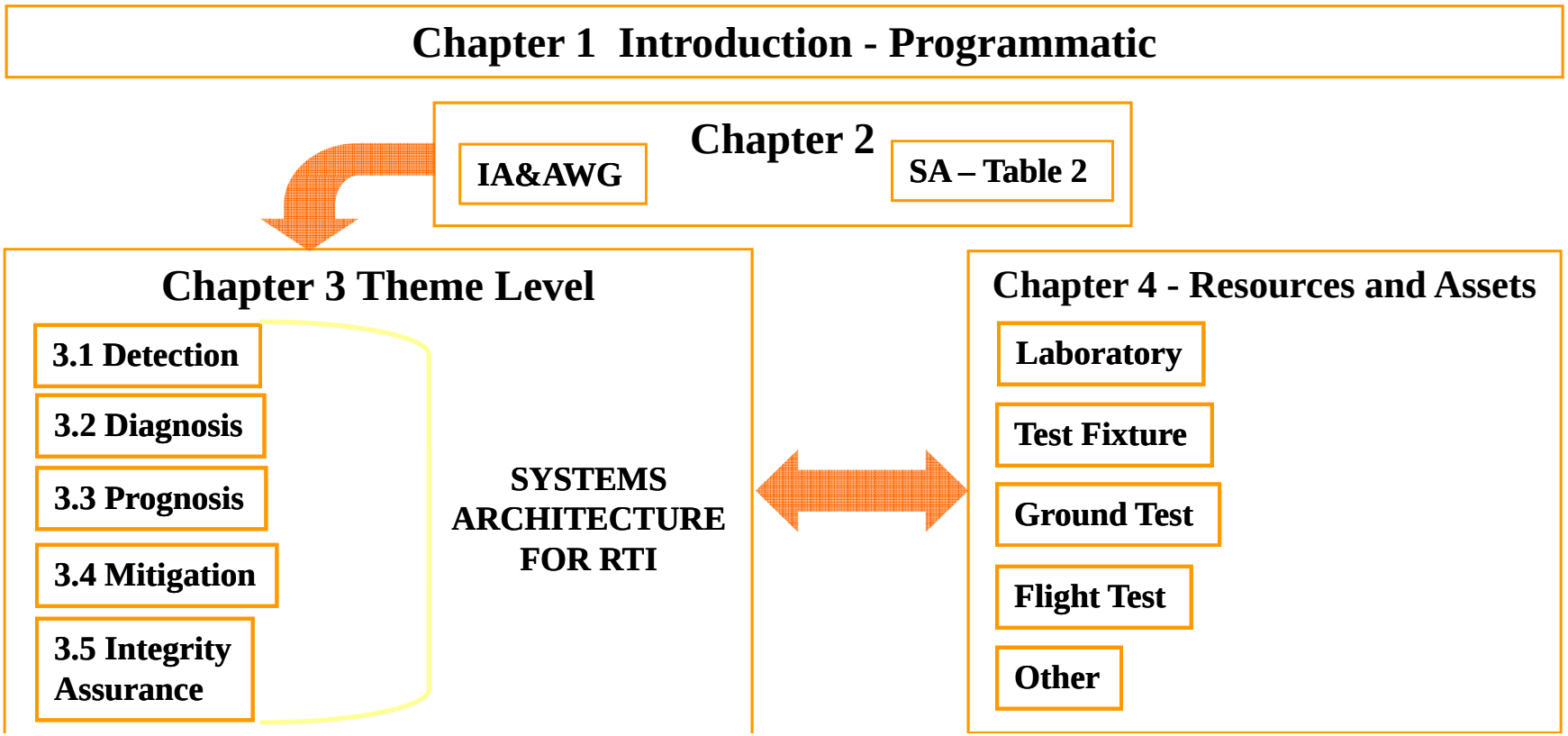

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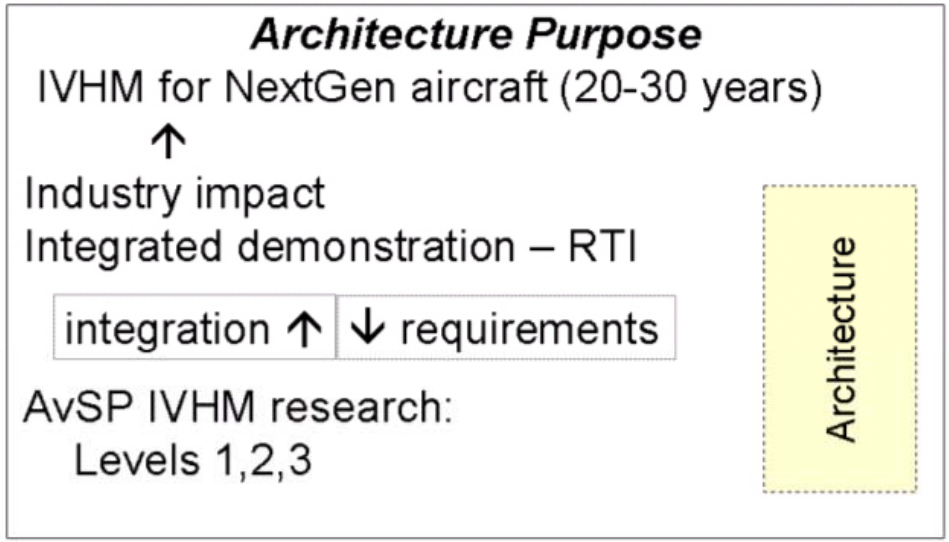

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  - Internal and external advisors reviewing and advising on IVHM Project's direction and studies

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  - Internal and external advisors reviewing and advising on IVHM Project's direction and studies
- DASHlink communication tool
  - Using Web 2.0 technology to promote IVHM collaboration, facilitate IVHM technology development, and foster/engage the next generation scientists and researchers
  - Publish IVHM Project Research Test and Integration / Systems Architecture developments and status

IVHM Level 4 - Vehicle Level
Team Leads

- Systems Analysis Team
  - GRC (Mary Reveley – lead), ARC
- Research Test and Integration Team
  - IVHM Project (PS – oversee and guide)
  - DFRC (Mike Venti – lead)
- Systems Architecture Team
  - NRA (Dr. Dimitry Gorinvesky – P.I.)
- Integrated Architecture and Assessment Strategy Working Group
  - IVHM Project (PS – lead)
- DASHlink communication tool
  - ARC (Elizabeth Foughty – lead)

IVHM Level 4 - Vehicle Level
Progress Status

- Systems Analysis Team
  - "Commercial Aircraft Integrated Vehicle Health Management Study"
  - "A Study on Current and Emerging Technologies and Future Research Requirements for IVHM"
  - Updating IVHM Tech Plan "Adverse Events Table"

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- Research Test and Integration Team
  - Strawman RTI Plan under development
  - RTI / Systems Analysis / Systems Architecture TIM meetings
    - Twice a month (webex, alternating site meeting at DFRC and ARC)

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- DASHlink communication tool
  - Investigating best approach to provide public access to RTI/Systems Analysis/Systems Architecture development s and status

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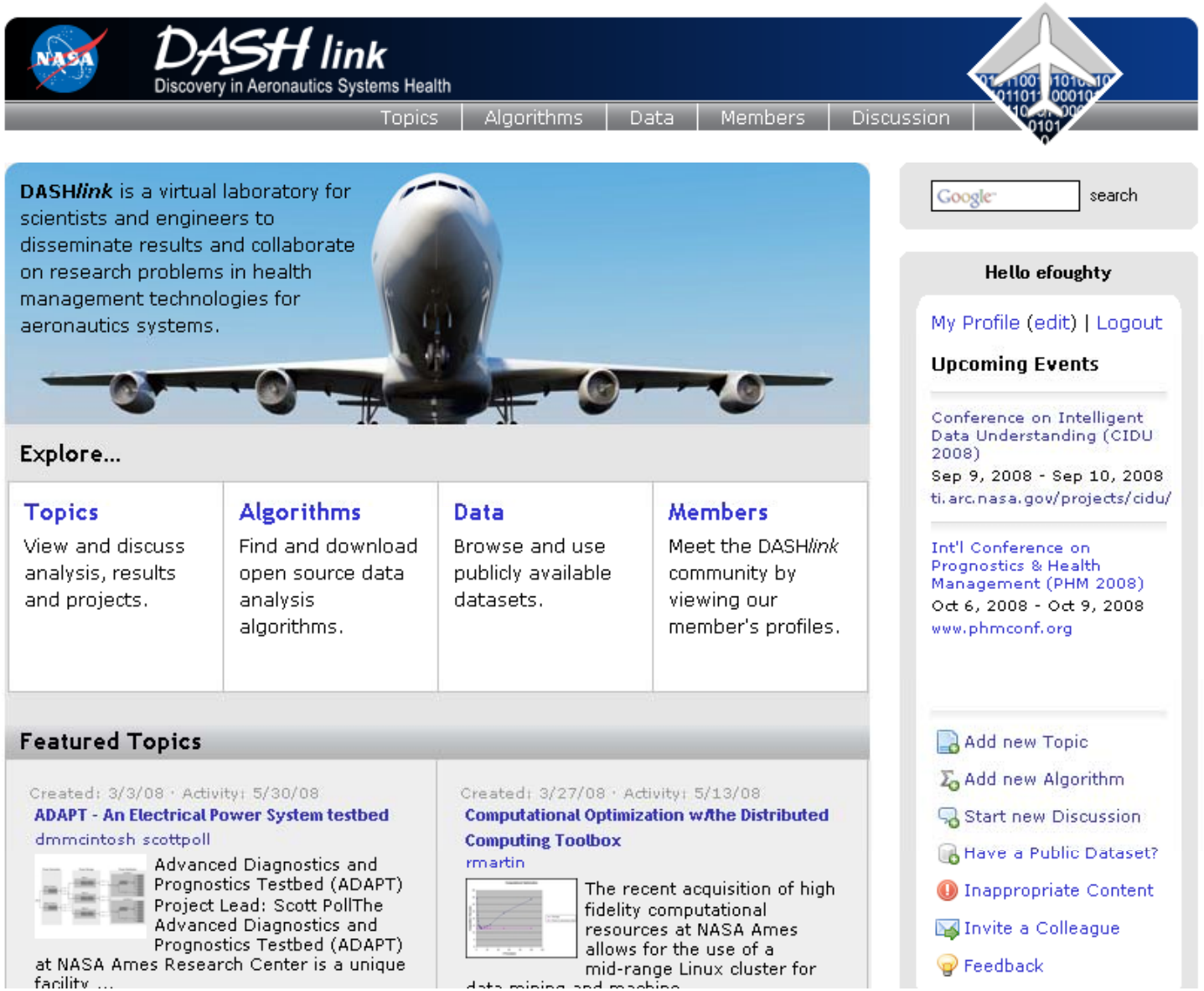
- Integrated Architecture and Assessment Strategy Working Group
  - Best direction and approach taken by IVHM Project - expert advice and lessons learned from working group
- DASHlink communication tool
  - Generated wide interest in NASA IVHM Project work. Facilitated the development of integrated IVHM technologies.

IVHM Level 4 – Vehicle Level

IVHM Project Public Access Portal



Thank You

IVHM Level 4 – Aircraft Level Technical Approach

Adverse Events Table

- Evaluated and updated by the Systems Analysis and Research Test & Integration teams to remain current with the trends in aviation
- Particular adverse events targeted in IVHM technology evaluations will be selected and documented.

Integration Architecture and Assessment Working Group

- NASA IVHM Researchers
- Academia
- Industry Partners
- Other gov't agencies

Testing Opportunities at NASA and Other Agencies

System Integration and Testing (Multidisciplinary Ground/Flight Demo)

Research Test and Integration Plan

Systems Analysis

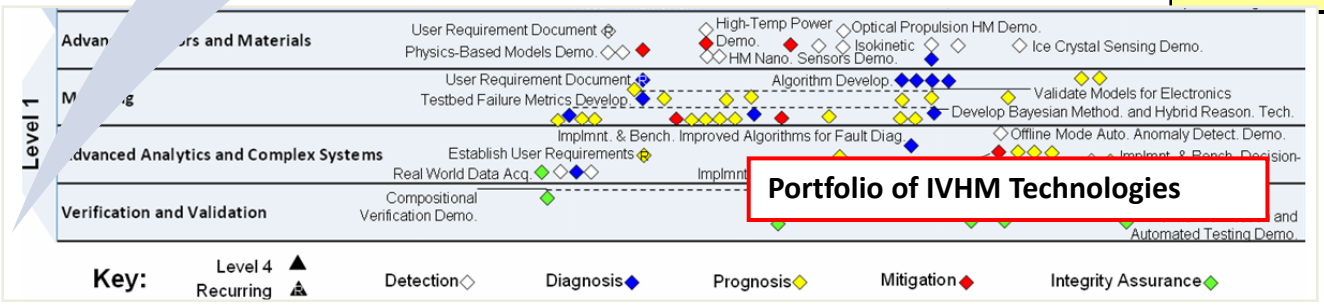
Adverse Event Type	Definition	Example Damage Condition
1. Incipient Faults	Hard to detect and differentiate due to extremely slow degradation in performance	1. Icing conditions in propulsion system 2. Fault of power electronics.
2. Slow Progression Fault	Very hard to detect, gradual degradation in performance	3. Fatigue cracks on metallic airframe structure 4. De-lamination in composites 5. Ball-jam in EMA
3. Intermittent Faults	Fault does not degrade but instead is a recurring hard fault that comes and goes, for example a signal conducted via a loose connector.	6. Wire chafing resulting in an electrical short due to an unexpected ground pat
4. Cascading Fault	Faults that may have a single root cause yet progress to create faults in other systems, subsyster or components	7. Pow
5. Fast Progression Fault	Limited prec signature degrad	inery adiation related ault are faults*

* Depending on the nature of ... could lead to a fast progression, as in the case of a stack overflow, or ... as in the case of a memory leak. Either way, a key challenge for IVH ... ods to manage these sorts of faults.

Sample Research Center	Name	Primary Number	Alternate Phone	Email	Position	Discipline
Center POC	Bob Protagonist			here@nasa.gov	F-22 Project Manager	Management/Systems Integration
Technical POC	Jill Hero			there@nasa.gov	Senior Propulsion Engineer	Propulsion
Technical POC	Doug Leader			somewhere@nasa.gov	Flow Physics Branch Chief	Computational Aerodyanmics
Technical POC	Dick Whitcomb			lost@nasa.gov	Wind Tunnel Director	Experimental Aerodyanmics
Technical POC						

Research Assets	Lab	Fixture	Aircraft	Other	Capabilities	Projected Availability	Estimated Cost/Unit
				Wright Computer Cluster		25% average utilization on 32 CPU cluster	None, if no upgrades or software purchases are required
			Big Aircraft			Periodic Dedicated Flights, Frequent Ride Along flights. Must schedule and prioritize with owning OGA.	$100K fixed, $22K/hr dedicated flight, $5K/flight ride along
		Thrust Stand				Schedule downtime for	
	Big Aircraft Simulator						
			Subscale RPV				

Test Opportunities



Portfolio of IVHM Technologies